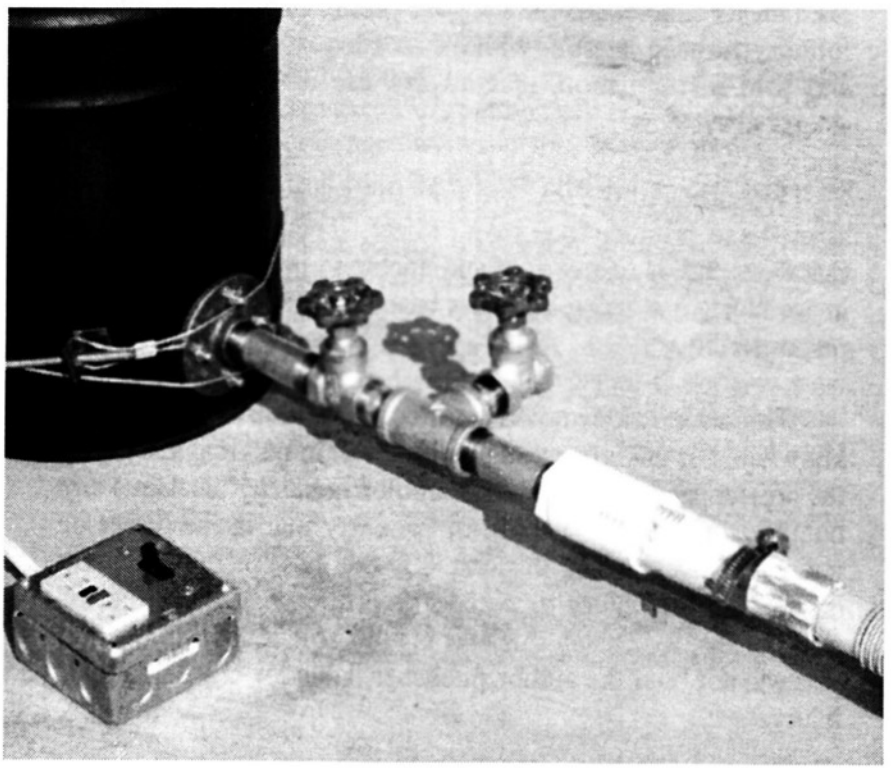
How to Build the Wet/Dry Vac Precision Air Controller for Forge and Foundry

Written and illustrated by
Don A. Meador



First Edition

Published by

Millennial Marketing
PO Box 247
Freeman, MO 64746-0247

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NOTICE OF DISCLAIMER

Warning! Using the Air Controller for a forge or foundry furnace is dangerous. You could receive severe burns from a coal or charcoal fire, burns from the hot metal, eye damage from staring at the bright light in the forge or foundry furnace, illnesses from toxic fumes caused by hot metals, electrical shock from the air source, and the list goes on. Do not use a forge or foundry furnace indoors without an adequate exhaust system and proper ventilation, and always use a GFCI circuit for electrical systems.

The author of the text presents this material as a guide for amateurs to produce their own project. There may be dangers that the author is unaware of and unable to inform you. Safety in producing and using a project based on this text is your sole responsibility.

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Introduction

One of the trickiest parts of using a solid fuel such as charcoal, coal, and coke for forge or foundry furnace is controlling the air flow. I found this out with my first experiences using a bucket sized charcoal foundry furnace. With my wet/dry vac set to exhaust, the hose was placed a foot or so away from the air inlet of the blast furnace and tilted off center with rocks and bricks to adjust the air to flow into the tuyere. Often too much air would blow into the furnace causing the fuel to burn too hot, melting the bottom of the metal pot that I was using for a crucible. This was also a problem with my Blacksmith's Firepot, but I was able to fashion a primitive air control on the firepot itself. The primitive air control worked well enough, but did not have a smooth action. When I built my Full Sized Coal Forge using a commercial firepot, I was faced with the same air control problem. This time I clamped a cardboard ring onto a brace on the back of the forge to hold the wet/dry vac's hose, and tilted the hose similarly to the way that I did for my foundry furnace. This worked all right, but I wanted something that was easier and less frustrating to use.

My first thought to solve this problem was to use a light dimmer switch on the wet/dry vac. However, a wet/dry vac, hair dryer or house vacuum cleaner depends on having the air flowing across the motor to keep them from burning out. Therefore, reducing the air flow would not be good for the motor. Besides, most of these types of motors will not work with a light dimmer control. So, this was not a feasible solution. The next obvious solution was to buy a hand cranked blower or an electric blower with a variable speed until I saw how much they cost. The best solution was to devise a way to control the air flow coming from my wet/dry vac.

I began by defining the requirements for an Air Controller. First, since the wet/dry vac depends on having air flowing over the motor to keep it cool, the air going into or going out of the vac must not be restricted significantly. Therefore, the Air Controller must divert some of the air flow into the forge or furnace while exhausting the rest of the air. Second, the Air Controller must attach solidly to the wet/dry vac and attach solidly to the forge or furnace so that the air flow does not depend on a balancing act. Third, in addition to being solidly attached to the Air Controller, the plastic hose from the wet/dry vac must be kept cool enough to prevent it from melting.

Fourth, and most important, there must be a smooth and precise way to control the air flow. In addition to these requirements, the Air Controller should be easily modified to use a hair dryer, house vacuum cleaner, or similar air supply.

The following pages contain the construction of an Air Controller that meets these requirements. It is designed so that commonly available plumbing parts are used. This project starts with the construction of an Air Diverting Unit that goes between the wet/dry vac and the forge or furnace. Next there is a description of how to construct a custom fitting receptacle out of PVC pipe for the wet/dry vac's hose and how to adjust this for a hair dryer and house vacuum cleaner. Note that when using a house vacuum cleaner, it's hose must be capable of being hooked-up to the vacuum's exhaust. Next, how to attach the Air Controller to Meador's Blacksmith's Firepot, a commercial firepot, and a bucket size charcoal foundry furnace are described. Finally, a GFCI hookup is described.

This project is very easy and can be constructed in a very short amount of time. I hope you like it as much as I do.

I want to thank Joan (my best friend, wife, copy editor, and associate), for all the support and help in producing this text.

Air Diverting Unit Construction

The Air Diverting Unit is the heart of the Air Controller and goes between the forge or foundry furnace and the air source be it wet/dry vac, hair dryer, or house vacuum cleaner. It is the easiest part of this project to construct. Its purpose is to allow some of the air from the wet/dry vac to go to the forge or foundry furnace and pass the rest of the air through another opening. This arrangement allows us to control the air flow and at the same time keep sufficient air flowing through the wet/dry vac to keep the vac's motor cool. Figure 1 shows the Diverting Unit.

The Air Diverting Unit is made with threaded gate valves and 3/4" black or galvanized pipe from the plumbing section of the hardware store. Gate valves are used instead of shut-off valves because they use a metal part to restrict the air flow where as shut-off valves use a rubber washer that could deteriorate quickly in this application due to heat. A larger size pipe that is closer to the size of the wet/dry vac's hose size could have been used, but 3/4" gate valves are much easier to find and are less expensive than larger valves. The

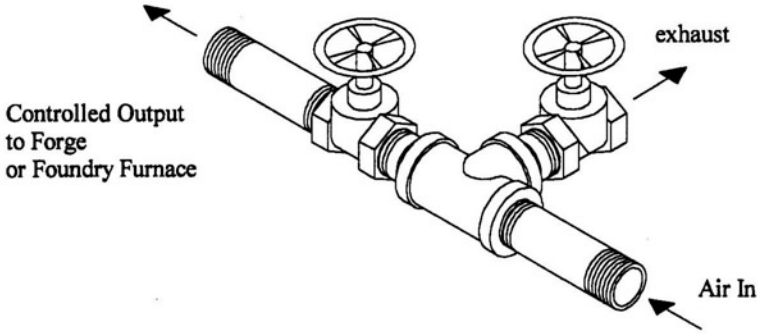


Figure 1

resistance of a smaller diameter pipe might seem to be of concern, but this application requires a short length of pipe and the wet/dry vac, hair dryer, and house vacuum cleaner typically puts out more air than is needed.

The exhaust gate valve shown may not be needed in some applications, but if there is insufficient air going into the forge or foundry furnace when the main valve is fully open, then the exhaust valve can be slightly closed to create more air pressure. This must be done cautiously to maintain sufficient air flow over the motor to prevent it from overheating.

The construction of the Air Diverting Unit is simple and only requires the following.

2 - 1 1/2" x 3/4" nipple
2 - 3 1/2" x 3/4" nipple
1 - 3/4" Tee connector
2 - 3/4" threaded gate valve

Assemble the parts without pipe compound as shown in Figure 1, and hand tighten the connections lightly. The wet/dry vac, hair dryer, or house vacuum cleaner does not supply enough pressure to require pipe compound or wrench-tightened connections. We just want to tighten the parts enough to keep them from moving. This also allows us to adjust the locations of the valves to a convenient place when the Air Controller is attached to our forge or furnace.

As you can see, controlling the air flow is actually very easy.

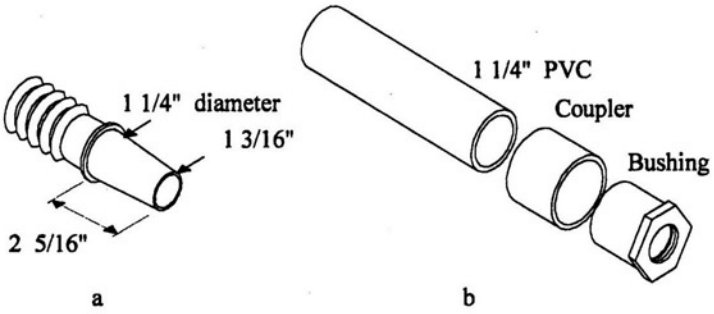


Figure 2

The more difficult part of this project is in attaching one end of the Air Diverting Unit to the wet/dry vac, hair dryer, or vacuum cleaner and the other end to the forge or foundry furnace. Let's look at how to make a connector that goes between the Air Diverting Unit and the wet/dry vac.

At the end of the wet/dry vac's flexible hose is a small section of ridged plastic tube that is tapered. The wet/dry vac's attachments are made with a complementary taper so that when the attachment is connected to the hose end, the two are held in place by friction. We need to make a part that has one end similarly tapered for the wet/dry vac hose and the other end so that it will attach to the Diverting Unit. In this way the Air Controller will work like any other wet/dry vac attachment.

Figure 2a shows the dimensions of my wet/dry vac hose, and Fig. 2b shows the exploded view of the parts that are required to make the custom fitting part.

The following is the list of parts required

1 - 6" section of schedule 40 1 1/4" PVC pipe.
1 - straight coupler
1 - 1 1/4" x 3/4" reducer bushing.
2 - hose clamps that open to 2" (not shown in Fig. 2b)
1 - J-B WELD® epoxy glue. Do not get the fast setting kind. (from the J-B WELD company)

My wet/dry vac is a small one. If you are going to use a wet/dry vac that has a substantially larger hose, a hair dryer, or house vacuum cleaner, you may need to use a larger diameter piece of PVC.

Using a different size PVC pipe also means that you will have to use a different size bushing and/or a reducer in order to end up with the 3/4" pipe thread at one end.

At the home center or hardware store you will find larger diameter pipes in 1 1/2", 2" and 3" size. Even though a 2 1/2" diameter pipe is manufactured, I have not found this diameter at any of the home centers or hardware stores in my area. However, with the following technique, you should be able to make a custom fit on a wide variety of sizes.

The inside diameter of the 1 1/4" Schedule 40 PVC is about 1 3/8 inches and the largest part of my wet/dry vac hose end is about 1 1/4 inches. Therefore, we not only need to make the PVC taper, but the entire length of the taper needs to be slightly smaller than the original diameter of the pipe. If your wet/dry vac is a little larger than 1 3/8 inches, you will only have to flare out a small amount from the original diameter of the PVC pipe. However, you may find it better to use a larger diameter pipe because it is easier to squeeze the pipe down than it is to flare out the pipe and fill large gaps.

First, measure the length of the wet/dry vac section of hose (or the length of the hair dryer or vacuum cleaner end) that is intended to fit inside the PVC pipe and add about 3/4 inch to this value. For my wet/dry vac hose shown in Fig. 2, this would be 2 5/16" + 3/4" = 3 1/16". Since it's better to be a little longer here, we will round to 3 1/8 inches. Then cut a 6 inch section of PVC schedule 40 pipe, square up the ends, and sand off the burs. Measure this distance from the one end of the pipe, and using a pencil, make a mark all around the PVC pipe.

Using a hand wood-saw, vertical cuts are made into the PVC as shown in Figure 3. A hand wood-saw is used because it will leave about a 1/8 inch gap that allows us to squeeze the tube into a smaller diameter. A good technique for sawing the PVC is cut only an inch at a time in each slot, then cut another inch in each slot, and so on until the pencil line is reached. This technique reduces the vibrations in the tabs making the sawing easier.

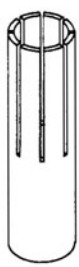


Figure 3

Hose clamps are used to force the PVC to the taper shape of the wet/dry vac hose. First we will dry fit the pieces to

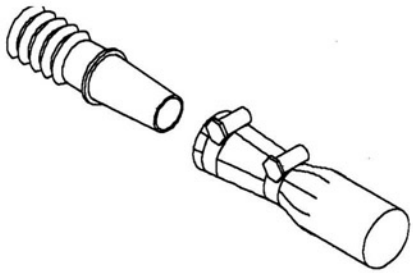


Figure 4

make sure everything will fit, and then we will glue it. Measure the length of the wet/dry vac hose that is intended to slip inside the PVC and make a mark on the outside of the PVC pipe so you will know where the end of the wet/dry vac is located. Slip the wet/dry vac hose into the PVC pipe, and put the hose clamps over the PVC pipe as shown in Fig. 4

In Fig. 4, the taper on the PVC is exaggerated so you can see how the pipe has to be reduced to fit the taper. Slide the wet/dry vac hose in and out of the PVC pipe and adjust the hose clamps until the PVC fits similarly to the fit that the wet/dry vac has with its own attachments. If you have trouble making the diameter small enough, cut the tabs further into the PVC or use a file, knife, or sand paper to increase the gap between the cut tabs on the PVC pipe. If you use sandpaper, be sure to rough up the pipe between the tabs with a file or knife so that the epoxy glue has something to grip.

When you feel confident that the fit is right, mark where the hose clamps are located on the PVC and then remove them. Cut off a section of kitchen wax paper and make two wraps around the end of the wet/dry vac hose. Be sure you have enough to cover all of the hose that will be near the PVC pipe, and twist the end so it won't slip off as shown in Figure 5. You can use a rubber band to hold the side that is outside of the PVC pipe, but this may not be necessary.

Get a disposable plastic picnic knife or popsicle stick to use for spreading the epoxy glue. Put a little Vaseline on the inside of the hose clamps so that glue wont stick to them. Mix up the J-B WELD® as described on the packaging. This will mix up as a paste. Spread the PVC tabs and push the epoxy into the cracks. When you have everything covered, slide on the hose clamps and put the wax paper

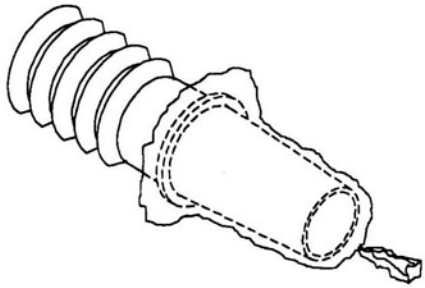


Figure 5

covered wet/dry vac hose into the PVC pipe. (If you forget the wax paper or do not get the hose covered well, the hose will be glued to the PVC pipe.) Put the hose clamps in place and adjust them for a good fit on the hose as you did before. The glue does not cure right away so you have plenty of time to adjust the clamps. The outside will have blobs of glue that should be wiped off without taking anything out of the cracks. Leave the hose inside the PVC pipe overnight.

The next day when you remove the hose and the wax paper, you will find that you have a good custom fit. Remove the hose clamps, file off the larger blobs of glue using a wood rasp, and then finish up with sand paper. Cleanup on the outside is strictly for cosmetic purposes. Look inside the PVC pipe and remove any large blobs of epoxy that might interfere with the air flow.

Hook up the hose to the wet/dry vac so that air blows out the hose. Slide the hose into the PVC pipe, and turn on the wet/dry vac. Hold your hand over the open end of the PVC pipe to block the air, and with your other hand feel around the PVC pipe for any large air leaks. A couple of small leaks are not important since the wet/dry vac puts out so much air. However, if you have any large leaks, remove the wet/dry vac hose, mix up some epoxy and patch up the holes. Let the epoxy dry overnight before you put the hose back in because even a little epoxy can permanently glue the hose to the PVC. You should put the hose clamps back on for extra support when you are done plugging the leaks.

Fit the PVC coupler onto the end of the section of PVC pipe that you just completed, and attach the bushing. This is then screwed onto the air control section. You could use pipe cement, but the frictions of these parts should be enough to hold everything in place.

If you do decide to use pipe cement, do it outside and away from sparks and open flames. This stuff puts off very strong combustible fumes.

The PVC pipe will have plenty of air flow and will be far enough away from the forge or furnace to keep it from melting. You must however keep the plastic away from any significant source of heat. If you notice the PVC pipe getting hot, you can pour a little water on the PVC and the metal pipe to keep it cool. Then before you use it again, put in a longer section of steel pipe on the Air Diverting Unit to increase the distance between the forge or foundry furnace and the PVC pipe

You now have the Air Controller completed and it is ready to be connected to your forge or foundry furnace. Here you are encouraged to think creatively in how to connect to your particular forge or foundry furnace. Three different connection methods will be shown to give you some ideas.

General Considerations for Connecting the Air Controller

In all three connection methods a floor flange is used. These vary in their style. In some cases the bolt holes in the flange are in the wrong location and need to be filled so that new holes can be drilled in the correct location. In some cases the bottom of the flange has some indentations to reduce the amount of metal used in manufacturing as shown in Fig. 6.

In order to make a good fit, these indentations and/or holes need to be filled, but since the floor flange will be connected close to the fire, we need to use something that will tolerate the high temperatures. The solution is to use Furnace Cement. Rutland makes

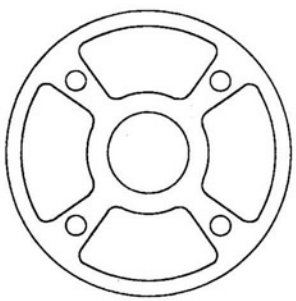


Figure 6

a good mix that is advertized to tolerate up to 2700°F which is a much higher temperature than we need. To use the furnace cement, you wet the surface of the metal and then pack the mix which looks like ordinary cement into the indentations and screw holes. You will most likely use your hands so you will need to have vinyl gloves to protect your skin. The mix will appear not to stick while it is wet, but it sticks very well after it has dried. Make sure you smooth over the areas very well because when the cement dries, you will have to use a grinder to remove the excess. Follow the directions on the container for best results.

Connection to Meador's Blacksmith's Firepot

Connecting the Air Controller to the firepot constructed from the text "How to Build a Blacksmith's Firepot" by Don A. Meador is very easy. The following are the parts required:

2 - 1/4 - 20 x 3" hex head bolts
2 - 1/4 - 20 nuts
2 - 1/4" lock washer
1 - 4 inch section 1 1/2" x 1 1/2" x 1/8" angle iron
1 - 8 oz container of Rutland Furnace Cement (if needed)

The floor flange typically has 4 bolt holes, and the distance between opposite bolt holes is just over 2 inches. This is perfect since the tuyere for the firepot was constructed using 2" x 2" 14 gauge

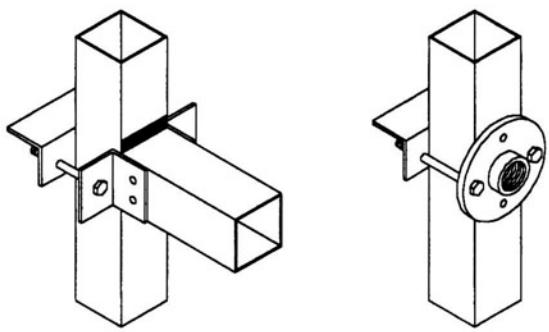


Figure 7

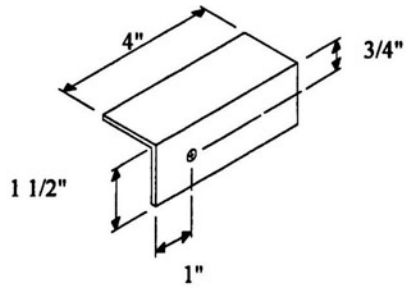


Figure 8

square welded tube. Therefore, bolts in two opposing holes of the floor flange will straddle the square tube. Figure 7a shows the original connection to the tuyere, and Fig. 7b shows the floor flange connection.

Construction is simple. First make sure that the bolt holes in the flange are far enough apart so that the bolts will straddle the square tube. If the holes in your flange are too close together, you have one of two options. You could drill two new holes separated by the correct distance and plug the unused holes with Furnace Cement, or you could use a 1" floor flange. A 1" floor flange will have bolt holes that are further apart, but in order to fit it to the 3/4" threaded pipe, you will need a 1" x 3/4" reducer and a 1" closed nipple.

A section of angle iron is used to connect the bolts on the opposite side of the square tubing. Cut a 4 inch section of 1 1/2" x 1 1/2" x 1/8" angle iron, and mark a center line lengthwise along the angle iron. Make a cross hair mark 1 inch from the end as shown in Fig. 8. Drill a 1/4 inch hole at the cross hair. Using a 1/4 - 20 x 1/2" or 1/4 - 20 x 3/4" hex bolt and a 1/4 - 20 nut, bolt the floor flange to the angle iron. Rotate the floor flange until you can see the center line in the opposing bolt hole of the floor flange and clamp the two parts in place. Drill a 1/4" hole in the angle iron using the floor flange as a drill guide. Unbolt and un-clamp the floor flange from the angle iron. Plug the unused bolt holes with the Furnace Cement as previously described and let it dry according to the Furnace Cement directions. Remove the original air connector from the firepot, and replace it with the floor flange and drilled angle iron as shown in Fig. 7b. Clamp the square tube between the angle iron and floor flange using two 1/4-20 x 3" hex head bolts, lock washers, and nuts.

Tighten everything down, and screw the Air Controller into the flange. The Air Controller is now ready for use.

For the operating procedure, see the later section "Running the Air Controller."

Connection to Commercial Firepot

There are several Commercial firepots available. In this text we will use the Centaur Vulcan firepot from Centaur Forge, Ltd., Burlington, WI that was used in the "How to Build a Full Size Coal Forge From Commonly Available Metal" This firepot has a typical 3" air inlet hole. A 3/4" floor flange can be clamped over the firepot's 3" air inlet since the floor flange's outside diameter is about 3 3/8". Then the Air Controller can be attached to the floor flange. If your firepot has a larger air inlet hole, then you will need to use a 1" floor flange. To connect the 1" floor flange to the 3/4" threaded pipe you will need a 1" x 3/4" reducer and a 1" closed nipple. The following are the parts required:

4 - 1/4 - 20 x 1 1/2" hex head bolts
4 - 1/4 - 20 nuts
4 - 1/4" lock washer
2 - 5 inch section 1 1/4" x 1 1/4" x 1/8" angle iron
1 - 8 oz container of Rutland Furnace Cement (if needed)

Notice that 1 1/4" x 1 1/4" x 1/8" angle iron is used. We could use 1 1/2" x 1 1/2" x 1/8" angle iron, but the 1 1/4" is proportioned a little closer to what we need.

Figure 9 shows how the floor flange is clamped to the air inlet hole. Notice that the bolts do not go through the floor flange. Instead the

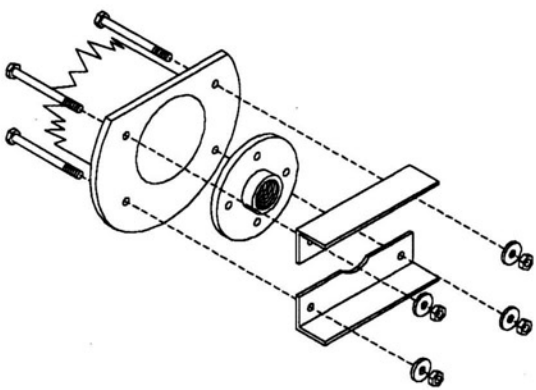


Figure 9

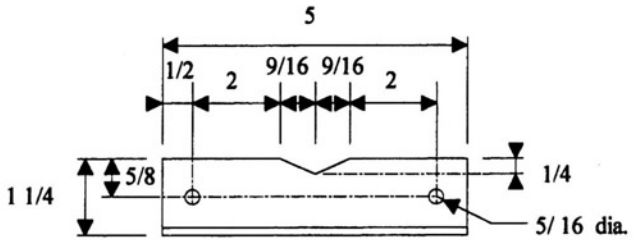


Figure 10

floor flange is squeezed between the firepot's flange and two sections of angle iron. Also, notice how there is a semicircle cut into the angle iron clamps so that the two angle irons fit around the lip for the 3/4" threaded pipe hole on the floor flange. This makes for good contact on the flat surface of the floor flange. Figure 9 shows the angle irons attached horizontally, but you could attach the angle irons vertically since the floor flange is held in place by the clamping action.

The first step in connecting the Air Controller is to make the angle iron clamps. Figure 10 shows the dimensions and initial cuts in the angle iron.

The two angle iron clamps are identical and both should be made at the same time. Measure the horizontal distance between the bolt holes on the firepot and mark this distance centered on your angle iron. Center punch these locations and drill the holes to 5/16" diameter. Next, along the edge of the angle iron that the bolt holes were drilled in, mark a point halfway between the bolt holes, and then make marks 9/16 inch from the center line on both sides of the center line. Make a mark 1/4 inch in from the center line. Scribe lines to make a V shape as shown in Figure 10. Using a hack saw, cut this V notch out of the angle iron.

The V notch now will be filed to fit around the 3/4" lip of the floor flange. Using a half round 10" bastard file, round the V notch. File the circular shape and then assemble the angle iron clamps and floor flange on the firepot. Note where the fit is poor and correct as needed. You want the angle iron in good contact with the flat part of the floor flange.

Assemble the angle iron clamps and floor flange to the firepot using 1/4-20 x 1 1/2" hex head bolts, lock washers, and nuts. Tighten this down securely. Then screw into place the Air

Controller. The Air Controller is now ready for use.

For the operating procedure, see the later section "Running the Air Controller."

Connection to Charcoal Foundry Furnace

My small wet/dry vac puts out a lot more air than is needed for the bucket or popcorn can size charcoal foundry furnace so you could just slip the end of the Air Controller up to the air inlet and have much better control of the air flow than previously. Larger foundry furnaces built from trash cans require more fuel and thus require more air. In either case, it is much better if you solidly attach the Air Controller to the air inlet than to just point it at the tuyere. The problem is that the furnace is round and the flange is flat.

The Air Controller is attached to a foundry furnace using the following parts:

1 - 3/4" floor flange
1 - 7 foot length of bare 3/32" diameter 7 strand steel cable
(The length is approximate. See text for details)
2 - 3/32" cable connectors (crimping type)
2 - 1" long sections of 1" x 1" x 1/8" angle iron
4 - 1/4 - 20 x 3/4" hex head bolts
6 - 1/4 - 20 nuts
4 - 1/4" lock washer
1 - 1/4 - 20 x 6"-threaded rod
(This is approximate. See text for details)
1 - 8 oz container of Rutland Furnace Cement
(This is optional.)

Using these parts, the Air Controller is essentially strapped over the air inlet of the furnace with four contact points.

Figure 11 shows how the flange is strapped onto the furnace. A threaded rod goes through two small sections of angel iron that connect to a steel cable. Notice how the cable crosses under the threaded rod. Nuts on the ends of the threaded rod are tightened to hold the flange tight over the air inlet. Before giving the assembly instructions, the length of cable and the length of the threaded rod that are required must be determined since your furnace may be of a different size than what is described in this text.

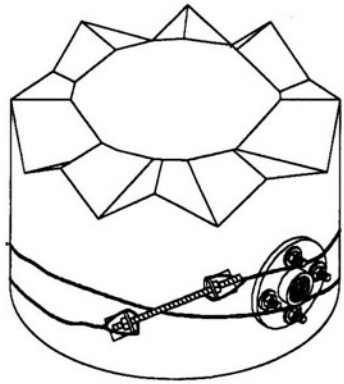


Figure 11

The parts list calls for a 7 foot length of 3/32" steel cable, and this cable should be bare cable without any plastic coating. The length should be twice the distance around the bucket close to where the tuyere is located plus an extra 1 foot. Measure the circumference of your bucket by wrapping a wire once around the outside near the tuyere. Then use a tape measurer or yardstick to measure the length of wire. You could use a string, but you must be careful not to stretch the string when taking the measurement or you could be off by a considerable amount. Multiply this measurement by 2 and add 1 foot. Since cable is usually sold by the foot, round this number up to the next foot. For example, if your circumference is 35 inches, You would calculate 2 x 35 = 70 inches. Adding 1 foot to this will give 70 + 12 = 82 inches. Next convert this to feet, 82/12 = 6.83 feet. Finally, rounding this up to the nearest foot, you would calculate 7 feet. When you get the cable, be sure to get the crimping style cable clamps for the size cable you bought. You will not need to buy a crimping tool because you will be using a hammer to crimp which works fine in this application.

The length of threaded rod is determined by the curvature of the foundry furnace and high school geometry. Figure 12 shows the diagram used to determine the length of the threaded rod.

In this drawing we are assuming that the brackets and rod are straight across the bucket, but, as seen in Fig. 11, they are actually tilted. This discrepancy will not be significant. The radius of the outside of the bucket in Fig 12 is shown at two locations, R_1 and R_2.

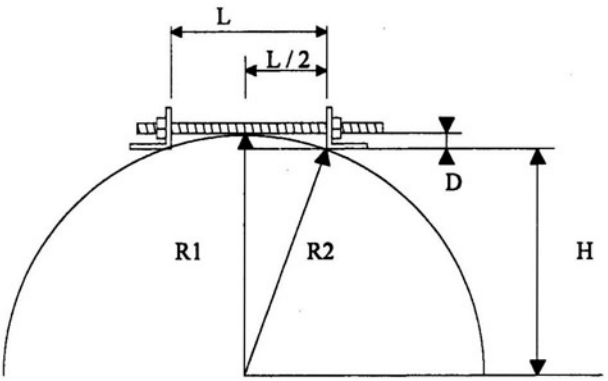


Figure 12

The length of rod between the angle iron supports is called L, the distance from the bottom of the threaded rod to the bottom of the angle iron is called D, and the height from the center of the circle to the bottom of the angle iron is called H.

Using Pythagorean's theorem, we can determine that

$$\frac{L}{2} = \sqrt{R_2^2 - H^2} \qquad \text{(Eq. 1)}$$

and from Fig. 12 we can determine

$$H = R_1 - D \qquad \text{(Eq. 2)}$$

Substituting this into the Eq. 1 we have

$$\frac{L}{2} = \sqrt{R_2^2 - (R_1 - D)^2} \qquad \text{(Eq. 3)}$$

Removing the subscript on the R's because they are the same value, and multiplying both sides of the equation by 2, we have

$$L = 2\sqrt{R^2 - (R - D)^2} \qquad \text{(Eq. 4)}$$

With Eq. 4 we can calculate the maximum length of the rod between the angle iron supports. The radius, R, is determined from the previously measured circumference of the furnace and the following equation

$$R = \frac{C}{2\,\pi} \quad or \quad R = \frac{C}{6.28} \qquad \text{(Eq. 5)}$$

Let's use the 35 inch measurement. The radius is therefore, R = 35 / 6.28 = 5.57 inches. Next, we will assume that the angle iron is drilled 1/2 inch from the bottom of the angle iron. Since the rod diameter is 1/4 inch, we subtract one-half of 1/4 inch from where the center of the hole is to determine where the bottom of the rod is located. Therefore the D value for Fig. 12 is 1/2 - 1/8 = 3/8 inch. Substituting into Eq. 4 we can calculate L

$$L = 2\sqrt{R^2 - (R - D)^2}$$

$$L = 2\sqrt{5.57^2 - (5.57 - 3/8)^2} = 4.02 \; inches$$

This value is for the length between the angle irons with the center of the rod touching the side of the bucket. We want some clearance between the rod and the bucket for the steel cable to cross under the rod so the required length between the brackets must be shorter than

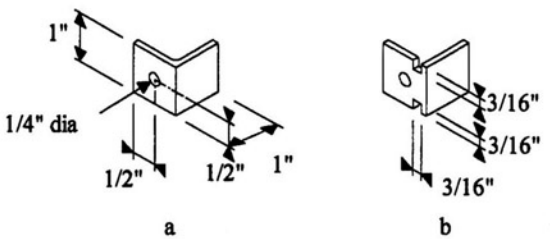


Figure 13

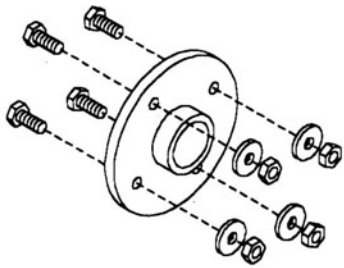


Figure 14

what we calculated, and we only need a couple of inches at the most to take up the slack. However, since the angle iron brackets with the threaded rod are at an angle, we may require more space between the brackets. Therefore, a 6 inch rod should be plenty. This just goes to show that we can use exact calculations, but in the end the calculated value will only give us a ball park value.

After we have calculated the cable length and the rod length, we need to make the angle iron brackets. The two brackets are identical and the details of the brackets are shown in Figure 13. The idea here is to make a slot for the 3/32" cable to fit in so it won't slip out of the brackets.

First drill the 1/4" hole in the center of each bracket as shown in Fig. 13a. The slots on the sides shown in Fig. 13b are cut into the angle iron just above the fillet of the inside corner of the angle iron using a hack saw. Measure and mark the location for the 3/16" slots, cut on the marks, and then using a screwdriver, remove the tab of metal between the hacksaw cuts. Using a small round file such as used to sharpen chain saws, round out the slot. This will make the opening a little wider and deeper. With a file, round the sharp edges so that the cable will not be cut by the metal when the cable is tightened.

Next the floor flange is prepared. Attach a 1/4 - 20 x 3/4" hex head bolt with lock washer and nut in each hole of the floor flange as shown in Fig. 14, and tighten the bolts. The bolts serve two purposes. First the heads of the bolts make four contact points like the legs of a table for a stable contact to the round surface of the furnace. If we did not have the four bolts for feet, the flange would rock back and forth causing an unreliable connection to the foundry

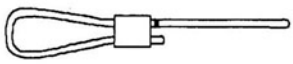


Figure 15

furnace. Second, the top side of the bolts give the steel cable something to hold on to so the cable will not pop off the flange.

Next, the cable ends are made. Make a mark about 6-1/2 inches from one end of the steel cable with a felt tip marker. Loop the end of the cable on to a cable clamp as shown in Fig. 15. Place the cable clamp over something sturdy like the anvil part of a vice, and hit it with a hammer to crimp the cable securely in place.

Put the threaded rod through the two angle iron brackets as shown in Fig 16. Adjust the hex nuts on the brackets so that the space between the brackets allows enough room for the cable to pass easily under the threaded rod.

Put the loop of the clamped end of the steel cable over one of the angle iron brackets. Wrap the cable around twice going over the floor flange as shown in Fig 11, and wrap the end of the cable around the other angle iron bracket through the 3/16" slots. Snug up the cable by pulling on the loose end of the steel cable. Hold the cable together and make a mark on both pieces of wire with a felt pen somewhere between 3 to 5 inches from the angle iron bracket. Remove the cable, and slip a cable clamp on the loose end. Align the marks on the cable and slide the cable clamp to a location similar to how the other end was clamped, and crimp the clamp on the cable.

All parts are now completed. Assemble the cable, brackets, and floor flange as shown in Fig. 11. Tighten the cable using the hex nuts on the angle iron brackets. The Air Controller is now screwed into the floor flange by tilting the forge up slightly. After assembly, if the Air Controller droops, then tighten the cable until it is firm. The Air Controller is now ready for use.

There will be some space created by the bolt heads on the floor flange, but since the wet/dry vac puts out so much air, this will most likely not be a problem. However, this gap can be closed by using the Furnace Cement. If you are planning on converting your charcoal furnace to a gas-fired furnace, you will need to close this gap. There are a number of articles written about drilling a hole in an elbow pipe and inserting a gas line which you may want to investigate.

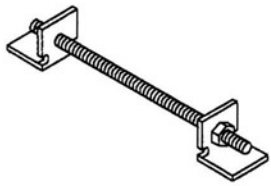


Figure 16

To seal the gap, follow the directions on the container for preparing the metal. You will need to work the Furnace Cement with your hands so you will want to have some vinyl gloves to protect your skin. Before you begin, put some Vaseline in the pipe threads so the cement will not stick. With only the floor flange strapped over the tuyere, push the cement in the crack being sure to keep the hole open and the threaded section clean.

Running the Air Controller

Running the Air Controller is very simple. The main idea is to keep plenty of air flowing over the wet/dry vac motor while supplying enough air pressure to the forge or foundry furnace. This is easily done by sound. Begin by opening the exhaust valve all the way and closing the valve to the forge or foundry furnace. Turn on the wet/dry vac. Slowly open the valve to the forge or foundry furnace. As you open this valve, more air will flow into the air inlet. If you get enough air flowing before you open the valve all the way, you are set. If you do not have enough air flow when this valve is opened all the way, then you can close down the exhaust valve to increase the air flow. Listen to the wet/dry vac. If it sounds like it is straining, you must have an obstruction in the line going to your forge or foundry furnace that you need to remove.

Basically that's all there is to controlling the air. You will notice that you can control the air very precisely. As the fuel level changes or clinkers accumulate, you can change the air flow, but be sure to keep plenty of air flowing over the motor. Whenever the wet/dry vac sounds like it is straining, shut it off and find the problem. The first few times you run the Air Controller be sure to monitor the temperature of the PVC. If it is getting too hot, pour some water over it as a temporary solution. A more permanent fix is to put a longer section of steel pipe between the PVC and the forge or foundry.

Ideas for Deluxe Connections

The ideas presented here are just the very basics. There is a lot more that can be done once the concept of controlling the air while maximizing air flow over the wet/dry vac motor have been addressed. You could add elbow connectors and extension pipes so that the pipe wraps around the coal forge bringing the valves to a convenient location. The exhaust could be connected to a soft copper pipe that runs a short distance up into the forge flue. Therefore, the excess air will pull the smoke into the flue.

Keep in mind that if you add more pipe between the flange and the Air Controller, you will need more support than just the connection at the flange. You could pipe the exhaust towards the ground where a T section connects to two other open ended pipes for a support leg. There are many other options if you use your imagination.

I find that the little switch on my wet/dry vac is not hearty enough for the constant on/off switching at the forge. So I built an electrical outlet box that has a house wall socket receptacle with an on/off switch. As an extra precaution, I used a GFCI, Ground Fault Circuit Interrupter, socket. If you have a relatively new house, you may find that the outdoor and garage wall sockets are already on a GFCI circuit. However, if you plan on doing any outdoor demonstrations where you are unsure if the circuit is GFCI, this will give you some piece of mind.

The electrical outlet is not difficult to construct, but if you have no experience with house wiring, then either get help from someone with experience or at least a good book on house wiring.

The following parts are required:

1 - GFCI receptacle (20 A)
1 - On/Off switch (20 A)
3 ft - 12 gauge with bare ground (12-2 with ground)
1 - steel square outlet box
1 - cable clamp for knock out opening
1 - metal face plate for toggle and duplex socket
2 - 6-32 nuts

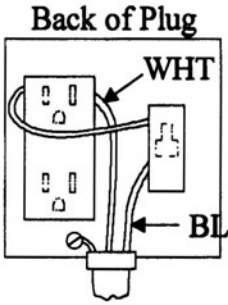


Figure 17

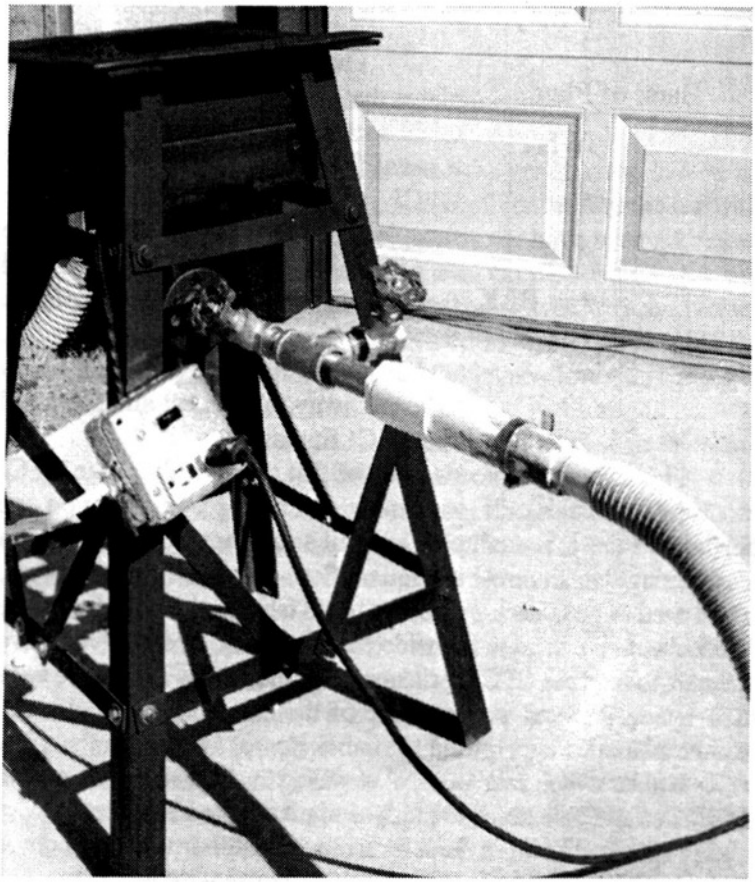
I have not found any metal face plates that have the square shape of the GFCI socket, and you will want to have a metal face plate. It is best to buy a GFCI that comes with a plastic faceplate, and use the plastic faceplate as a template for reshaping the metal faceplate opening. Just align the plastic faceplate over the duplex socket opening, and using an awl, scratch what needs to be cut away. Then cut and file until the GFCI fits inside.

The square box needs to be of full depth because the GFCI socket is relatively thick. If you cannot find a deep box, then you can either buy a raised face plate which will add about 1/2" depth, or an extension ring that fits over the square box. Besides fitting in depth, you will need to bend back part of the metal tabs on the switch and the GFCI socket to get them to fit inside the metal box, and you will have to use nuts to hold the GFCI socket onto the faceplate. To get the wire routed inside the box, pop out one of the knockout holes close to where the switch will go, put in the cable clamp, and slip in the wire.

Unlike switch and wall socket wiring in sheet rock, the switch and GFCI socket will attach to the face plate. Only a few feet of wire has been specified because flexible three wire outdoor extension cords are a lot easier to route around than 12-2 house wire is.

From here, the wiring is straight forward, just be sure to get the bare wire connected to the green terminal of the GFCI socket, the white wire to the silver terminal, and the black wire to the copper terminal. Figure 17 shows a simplified wiring diagram as seen from the back side of the socket and switch. Keep in mind that normally the on/off switch goes in series with the hot wire (black.) Be sure to wire the power to the LINE terminals and not the LOAD terminals. After you assemble the parts do not forget to tighten down the cable clamp on the metal box. Finally, test the GFCI as described in the literature that comes with the socket.

When you have completed your Air Controller and the GFCI circuit box, get ready for others to complement you on your ingenuity. Have a good time, keep safety in mind first, and Good Luck.



After you built a solid fuel foundry furnace, blacksmith's firepot, or forge with little money, you looked for a source of forced air for it. When you discovered what a foundry or forge blower cost, you decided to use a wet/dry vac, hair dryer, or a house vacuum cleaner. With the vacuum set to exhaust, you pointed the hose towards the air inlet and adjusted it a little off-center so that just the right amount of air blew into the opening. Everything was ready, and then your clumsy trick-foot kicked the hose forcing you to waste the next twenty minutes readjusting the hose. If this sounds like your experiences and you would like to convert that wasted time into useful foundry or blacksmithing time, then this text is for you. In these pages you will learn how to build an Air Controller that will custom fit to your wet/dry vac and give you precise control over the air flow. In addition, detailed instructions are given on how to make a rock-solid connection of the Air Controller to a commercial firepot used on a coal forge, to Meador's Blacksmith Firepot, or to a bucket foundry furnace. Get this text so you can precisely control your air source and have more fun with your hobby.